Evaluate Bull Trout Movements in the Tucannon and Lower Snake Rivers

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Evaluate Bull Trout Movements in the Tucannon And Lower Snake Rivers

Project Number 2002-006-00
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Annual Report – FY 02
(April 1, through November 30, 2002)

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Abstract

We collected, radio-tagged, and PIT-tagged 41 bull trout at the Tucannon River Hatchery trap from May 17, through June 14, 2002. An additional 65 bull trout were also collected and PIT tagged by June 24, at which time we ceased PIT tagging operations because water temperatures were reaching 16.0°C or higher on a regular basis. Six radio-tags were recovered shortly after tagging, and as a result, 35 remained in the river through November 30, 2002.

During the month of July, radio-tagged bull trout exhibited a general upstream movement into the upper reaches of the Tucannon Subbasin. We began to observe some downstream movements of radio-tagged bull trout in mid to late September and throughout October. These movements appeared to be associated with post spawning migrations. As of November 30, radio tagged bull trout were relatively stationary, and distributed from the headwaters downstream to river mile 11.3, near Pataha Creek. None of the radio-tagged bull trout left the Tucannon Subbasin and entered the federal hydropower system on the mainstem Snake River.

We conducted some initial transmission tests of submerged radio tags at depths of 25, 35, 45, and 55 ft. in Lower Monumental Pool to test our capability of detection at these depths. Equipment used included Lotek model MCFT-3A transmitters, an SRX 400 receiver, a 4 element Yagi antenna, and a Lotek "H" antenna. Test results indicated that depth transmission of these tags was poor; only the transmitter placed at 25 ft. was audibly detectable.

Acknowledgements

This study was funded by the U.S. Department of Energy, Bonneville Power Administration (BPA), Project number 2002-006-00, Contract number 00009774. Roy Beaty served as the BPA Contracting Officer's Technical Representative. The authors would specifically like to thank Ray Weldert for his diligence in fish handling, radio tracking and surgical expertise; Micki Varney for her assistance in tracking and technical support; the Washington Department of Fish and Wildlife Snake River Laboratory for lending us telemetry receivers and other equipment; and Doug Maxey, Mike Sutterfield, and Lyle Leslie of the Washington Department of Fish and Wildlife Tucannon Fish Hatchery for operation of the Tucannon trap and assistance with this study.

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Introduction

The recent listing of the Columbia River Distinct Population Segment of bull trout identified one of the major threats to the species as fragmentation resulting from dams on overwintering habitats of migratory subpopulations (Federal Register, 1998). It is possible that a migratory subgroup in the Tucannon River utilizes the mainstem Snake River for adult rearing on a seasonal basis (Underwood et al., 1995). The occurrence of bull trout in the hydropower system has been verified by a few incidental observations during sampling in Lower Monumental Pool (Buchanan et al. 1997 citing Ward), and in the adult passage facilities at Lower Monumental and Little Goose dams in the early 1990s (Kleist, in litt. 1993). Until recently, no attempts at adult fish enumerations were made at the Lower Monumental or Little Goose fish counting windows from Nov. 1 through March 31; bull trout are now counted year-round, with the exception of one month, usually January, when the adult ladder is de-watered for maintenance. Unfortunately, the past scheduled abandonment of fish counting activities coincides with adult bull trout movements into larger mainstem systems for adult rearing and foraging as indicated in other Columbia Basin subpopulations (Elle 1995; Faler and Bair 1992; Kelly Ringell and DeLaVergne 2000 and 2001; Schriever and Schiff, 2003; Theisfeld et al. 1996; Underwood et al. 1995). As a result, it is unknown if the existing fishways at the lower Snake River dams are suitable for bull trout passage, or if migratory fish originating from the Tucannon River attempt to pass these facilities on a regular basis.

The potential for bull trout movements throughout the migratory corridor is high, but from the standpoint of future delisting and requirements set forth in the FCRPS Biological Opinion (USFWS, 2000) the determination of temporal and spatial distribution in the mainstem is crucial in developing recovery actions, estimating "take", and successful consultation on system improvement actions. This project was designed to help meet Reasonable and Prudent Measures, and Conservation Recommendations associated with the Lower Snake River dams in the FCRPS Biological Opinion, and to increase understanding of bull trout movements within the Tucannon River drainage.

Rieman and McIntyre (1993) describe unimpeded migratory corridors as important habitats to the persistence and interaction of local populations. They also indicate that disruption and/or modification of migratory corridors can increase stress, reduce growth and survival, and potentially result in the loss of migratory life-history types in a subpopulation. With these factors in mind, the primary question to be answered is: Does the existing hydropower system on the Lower Snake River limit the capabilities of Tucannon River bull trout to complete their migratory behavior, or are the current hydropower operations compatible with recovery and conservation of the species? The secondary goal of the project is to examine the movements and spatial/temporal distribution of migratory bull trout within the Tucannon River and to determine the proportion of migratory fish that leave the Tucannon River to overwinter. The bull trout stock status in the Tucannon River is considered healthy by the Washington Department of Fish and Wildlife (WDFW 1998), but little is known about their migrations in the Tucannon and Snake river subbasins. Underwood et al. (1995) conducted a radio telemetry study of adult bull trout within the Tucannon River. However, the radio telemetry was only part of a larger study so the tracking data were limited (with only a few fish tagged and only one winter of tracking) and it therefore did not provide a complete assessment of the migrations and movements of bull trout.

The objectives of this study are to:

1. Determine the spatial distribution, migration timing, and movements of adult migratory bull trout in the Tucannon and Snake rivers.

2. Determine bull trout use and passage efficiency in fishways at Lower Snake River dams.

3. Estimate frequency of bull trout fall-back at Lower Snake River dams.

4. Determine if bull trout losses result from movements out of Lower Monumental Pool.

The primary assumption associated with the study is that the movements of radio-tagged bull trout are not different from the movements of other bull trout in the subgroup. This assumption is critical to the project as a whole. The use of long-life transmitters and tagging well before spawning or major migrations should reduce the effects of tagging on fish behavior. Martin et al. (1995) found that surgically implanted dummy transmitters did not affect fish survival, growth, or gonad development in rainbow trout held in captivity. Radio transmitters have been used in other bull trout studies in recent years with good success (Elle 1995, Faler and Bair 1992, Kelly Ringel and DeLaVergne 2000/2001, Schriever and Schiff 2003, Underwood et al. 1995). Objectives 1, 2 and 4 have critical assumptions, in part, associated with each of those objectives. In order to determine distribution in the Snake River (Objective 1) and passage efficiency (Objective 2), we must assume that a portion of our group of radio-tagged bull trout will enter the Snake River and at least attempt to pass through a fish ladder in the Lower Snake River. Likewise, in order to estimate the extent of losses in Objective 4, there must be some movement (upstream or downstream) of radio-tagged bull trout out of Lower Monumental Pool, and we also assume that radio transmission will be adequate to track bull trout movements throughout the reservoirs.

Study Area

The Tucannon Subbasin encompasses the entire Tucannon watershed and all tributaries (approximately 502 square miles). The stream system originates in the Wenaha-Tucannon Wilderness Area, in the northeast portion of the Blue Mountains at an elevation of 6,234 feet (at Diamond Peak) and terminates at the Snake River (RM 62) at an elevation of 540 feet (Figure 1). Dryland agriculture and livestock grazing are the dominant land uses in mid-elevation upland areas, while forestry, recreation and grazing are the primary land uses at higher elevations. The subbasin is characterized by deep v-shaped valleys in headwater areas gradually widening into comparatively broad valley bottoms on the lower mainstem of the Tucannon River and Pataha Creek. The topography is the result of folding and faulting of extensive deposits of Columbia River Basalts. Highly erodible loess soils on the plateau tops support extensive acreages of dryland farming. There is generally a large difference in elevation between the valley bottom of the drainage network and the surrounding plateaus. Intermittent and/or ephemeral streams are present throughout the watershed. Under typical conditions these streams do not convey much water, but during thunderstorms or rain-on–snow events they are capable of carrying immense debris torrents into the Tucannon River. The

sediment-moving capacity of these small streams is easily seen in the extensive alluvial fans deposited at their mouths. Habitat conditions in the Tucannon Subbasin range from generally fair to good in the Tucannon Drainage to generally poor in the Pataha Drainage.

Salmonid bearing streams in the subbasin include Bear Creek, Sheep Creek, Cold Creek, Panjab Creek, Turkey Creek, Meadow Creek, Little Tucannon River, Hixon Creek, Cummings Creek, Tumalum Creek, Pataha Creek, and the mainstem Tucannon River. Summer steelhead/rainbow, spring chinook, fall chinook, resident rainbow trout, and bull trout are currently present. Summer steelhead/rainbow are presumed to be present in Kellogg and Smith Hollow creeks. Coho were historically present, and in recent years, coho have again begun using the lower reaches of the mainstem Tucannon river. It is likely that the coho recently found in the Tucannon watershed are stray individuals from nearby tribal hatchery reintroduction efforts.

The Tucannon River enters the Snake River at RM 62.5 (RK 100.6) in Lake Herbert G. West, delineated by Lower Monumental and Little Goose dams on the downstream and upstream ends, respectively. Lyons Ferry Hatchery occurs a few miles downstream of the Tucannon mouth, at the confluence of the Snake and Palouse rivers. This portion of the Snake River is primarily a migration corridor for anadromous salmonids. Spring chinook and summer steelhead use the Snake River to migrate to and from the ocean and/or between tributary streams, while fall chinook use the Snake for spawning, rearing and migration. Sockeye migrate through this corridor to and from spawning grounds in Idaho's Salmon River Basin.

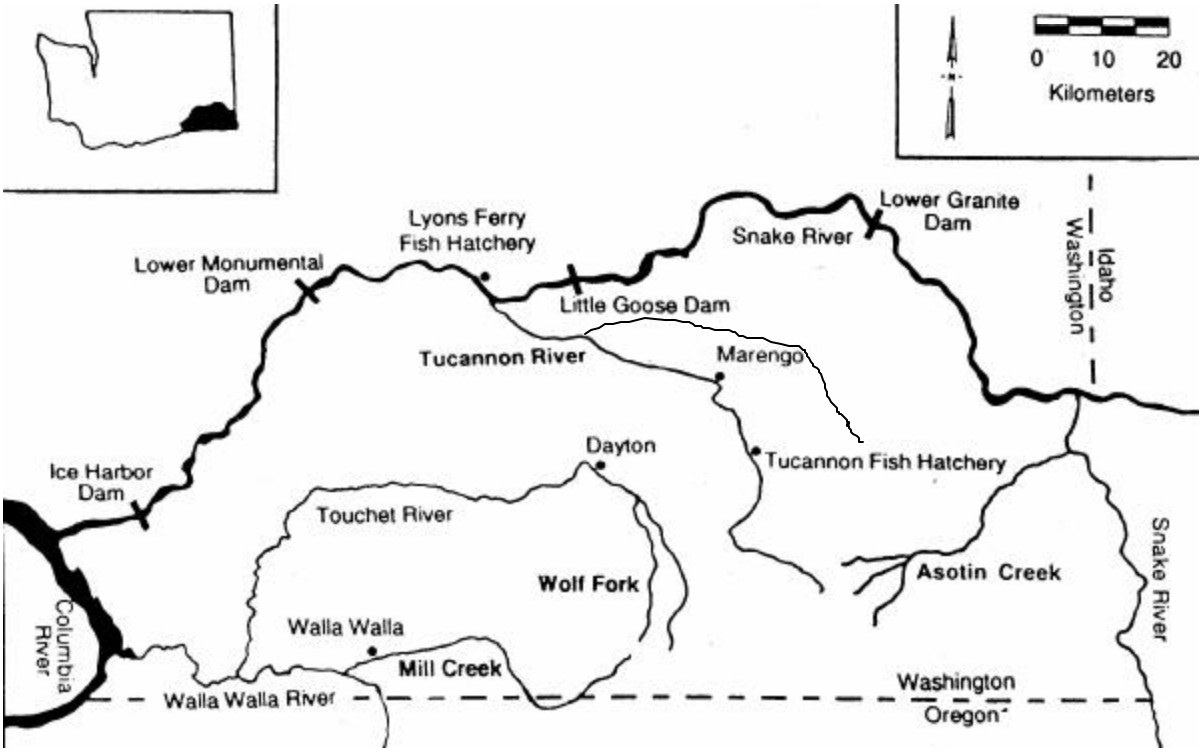

Figure 1. Map of Southeast Washington showing the location of the Tucannon River in relation to the four Lower Snake River dams.

Methods and Materials:

The approach of the study is to use radio-telemetry to monitor the movements of adult bull trout within the Tucannon river basin, and as they emigrate to the Snake River to rear throughout the winter. We attempted to capture bull trout in the lowermost 5 river miles of the Tucannon River during April with seines and angling gear without success. We were successful at capturing and tagging adult bull trout at the Tucannon Hatchery weir in May and June. Fish of appropriate size ($\geq$ 50 times transmitter weight in air) were surgically implanted with 399-761 day life expectancy radio-tags. Surgical procedures generally followed those used by Faler et al. (1988), Faler and Bair (1992), Kelly Ringel and DeLaVergne (2000/2001), and Schriever and Schiff (2003).

Radio tags for this study were obtained from Lotek Engineering. We utilized 3 different models/sizes of 3V micro coded fish transmitters: 1) model MCFT-3BM weighed 7.7g in air, had a 400 day life expectancy with a 12 sec burst rate, and was suitable for fish as small as 385 g, 2) model MCFT-3EM weighed 8.9g in air, had a 399 day life expectancy with a 5 sec burst rate, and was suitable for fish as small as 445 g, and 3) model MCFT-3A weighed 16.0g in air, had a 761 day life expectancy with a 5 sec burst rate, and was suitable for fish as small as 800 g. All tags operated on 149.380 mHz (Lotek Channel 4) and were individually micro-coded for easy separation of individual fish.

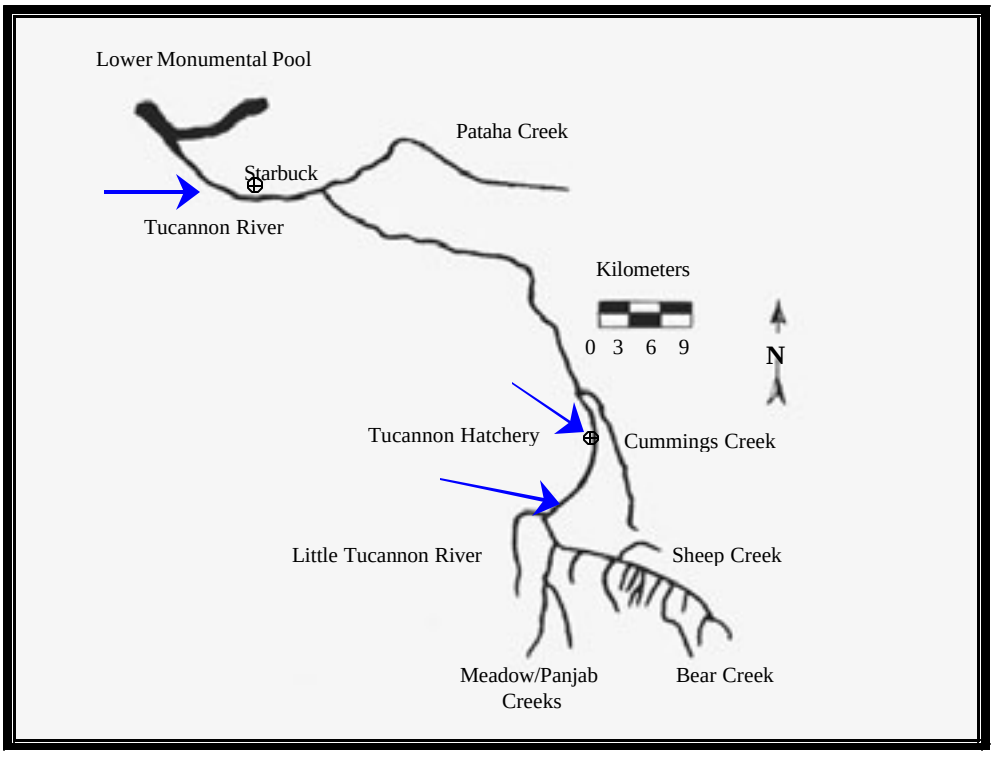

Figure 2. Fixed telemetry data logger stations (indicated by arrows) in the Tucannon Subbasin, fall, 2002.

Radio-tagged fish locations were monitored at least weekly in the Tucannon River from shore or aircraft. Individual fish locations were recorded by GPS coordinates during flights, and proximity to landmarks and/or road miles while tracking on shore. In addition, three fixed telemetry sites were established and operated continuously in the Tucannon Subbasin (Figure 2). The lowermost site, at river mile 1.6, was established to identify the timing of movements out of the Tucannon Subbasin and into the mainstem Snake River. Two other fixed sites (the Tucannon Hatchery weir, and Camp Wooten) were operated to record timing of fish movement into and out of the upper Tucannon River.

Depth Transmission Tests

During the months of September and November, we submerged radio-tags at depths of 25, 35, 45, and 55 ft. in Lower Monumental Pool to test our capability of detection at these depths. Radio-tags were secured with rubber "O" rings and electrical tape on 5/8" braided nylon rope 5-6 feet above 5 lb pyramid lead anchors. Each transmitter was affixed to the rope so it would be positioned with the transmitter's long axis horizontal under rope tension. Each rope was also affixed with a surface buoy marker for easy location and retrieval. We used Lotek model MCFT-3A transmitters, an SRX 400 receiver, and both a 4-element Yagi and "H" antenna. Tests were conducted from a boat and a helicopter.

Results and Discussion

Prior to the 2002 migration, picket width at the Tucannon Hatchery weir was modified to capture more bull trout. Two hundred and eight bull trout were captured at the Tucannon Hatchery weir in 2002 (see Table 1 below, and Appendix Table A). Forty one of these were measured, weighed, marked with a PIT tag, radio-tagged, and released above the weir. Sixty-three additional individuals were marked only with a PIT tag and released above the weir. The remaining 104 captured bull trout were simply enumerated and released.

Table 1. Bull trout trapping data at the Tucannon Hatchery weir, 1998-2002.

Year	Number of Bull Trout Captured	Capture Dates	Average Length	Number of Bull Trout with Length # 260 mm
1998	82	4/1 - 8/29	396 mm	1
1999	39	5/20 - 7/12	449 mm	0
2000	41	4/17 - 8/29	437 mm	0
2001	39	5/12 - 6/27	469 mm	0
2002*	208	5/17-7/31	404 mm	0

*For detail, refer to Appendix A: Bull Trout Trapping and Tagging Log

Of the 41 radio tags implanted in bull trout, 5 were recovered (Table 2). One tag (code 70) was implanted in a bull trout on May 22, and that fish subsequently moved steadily

downstream; the tag was recovered approximately 6 river miles downriver. Although the host fish was not recovered, due to the immediate and rapid movement downstream, it is likely this fish died due to injuries or disease exacerbated by surgery. This tag was subsequently implanted in another bull trout on June 14. Two tags (codes 81 and 86) were recovered with a carcass and/or remains, proving conclusively that the host fish died. One tag (code 88) was recovered near signs of a predator; otter scat and tracks were in the area of the tag, and the antenna showed signs of having been bitten. It is likely that this fish died, although this is not substantiated. One tag (code 62) has not been recovered, but has been transmitting from seemingly the same location since August 6. Project personnel have performed multiple unsuccessful attempts to recover this tag. It is likely that a live bull trout no longer carries this tag. Finally, 1 tag (code 77) was recovered without any evidence as to final disposition of the host fish. This radio tag was recovered in nearly new condition. A possible explanation for the recovery of tag code 77 is that the host fish rejected the tag.

Table 2: Known and Suspected Mortalities, and Recovered Radio Tags, In the Tucannon Subbasin, June - August 2002.

Code	Date of Recovery	Implant Date	Final location	Tag Condition	Comments
62	N/A	5/19/02	Vicinity of W. T. Wooten WA campground #5	N/A	Tag has not been recovered.
70	6/13/02	5/20/02	1.5 miles downstream of Marengo bridge	Good	Tag found without carcass Tag re-implanted in another fish on 6/15/02.
77	8/21/02	5/26/02	0.1 mi. upstream of USFS 180/47 intersection	Excellent	Tag recovered underwater on cobble bed. No trace of fish. Tag may have been rejected.
81	8/6/02	5/30/02	0.4 mi. upstream of Cummings bridge	Good	Tag recovered on streamside gravel bar. Scattered remains (bone, cartilage etc.) around tag.
86	7/24/02	5/28/02	~400m upstream of Beaver-Watson Lakes bridge	Excellent	Carcass recovered in fresh condition headburn, fungus. No sign of predator wounds.
88	7/24/02	6/13/02	0.6 miles upstream of Cummings bridge	Antenna appears to have been chewed on.	Tag recovered under brush pile, with otter scat nearby.

During the month of July radio-tagged bull trout exhibited a general upstream movement but remained relatively close to the tagging and release point (Figure 3). Post-tagging recovery may have slowed or delayed migration during this period.

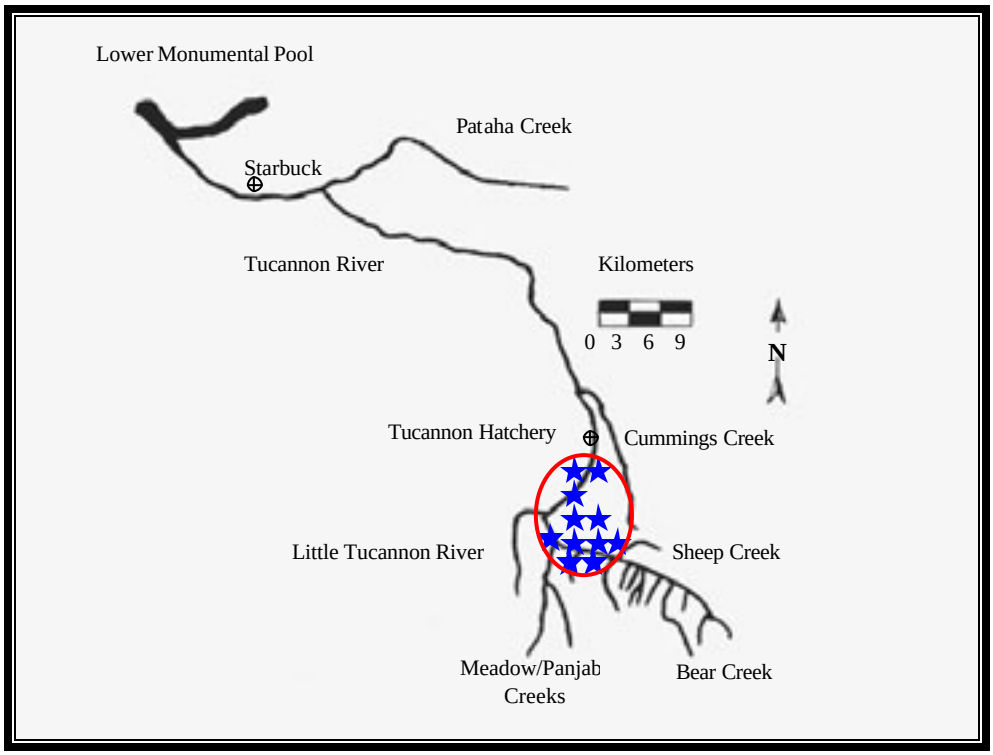

Figure 3. Distribution of radio-tagged bull trout in the Tucannon Subbasin in July, 2002. Each star may represent more than one fish location. The oval represents a high concentration of fish locations.

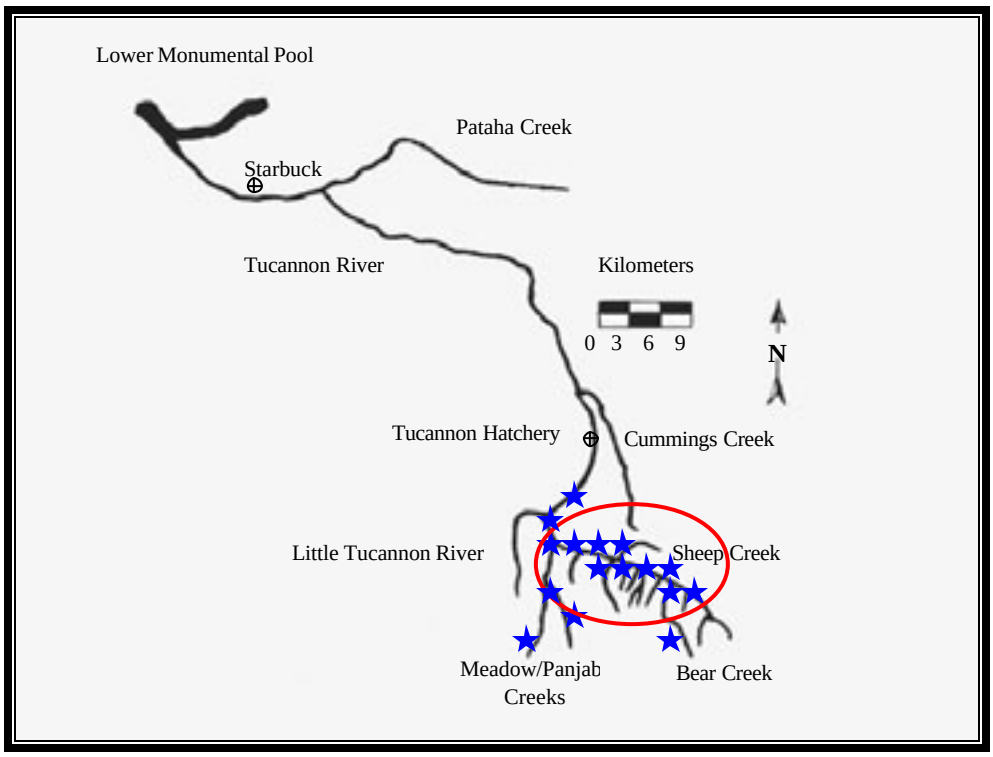

Figure 4. Distribution of radio-tagged bull trout in the Tucannon Subbasin in August and September, 2002. Each star may represent more than one fish location. The oval represents a high concentration of fish locations.

Later in the summer and into September, bull trout moved into known spawning areas in Bear, Panjab/Turkey and Meadow creeks, and the upper mainstem Tucannon River (Figure 4).

Post-spawning movements in October and November (Figure 5) were similar to those observed in the Tucannon River by Underwood et al. (1995), and typical of post-spawning movements observed in other migratory populations (Elle 1995; Faler and Bair 1992; Kelly Ringel and DeLaVergne 2000/2001; Schriever and Schiff 2003; Theisfeld et al. 1996). By the end of November, there were a total of 5 individuals residing within the lowest 17 miles of the Tucannon River. The furthest downstream detection was near the confluence with Pataha Creek, downstream of Highway 12.

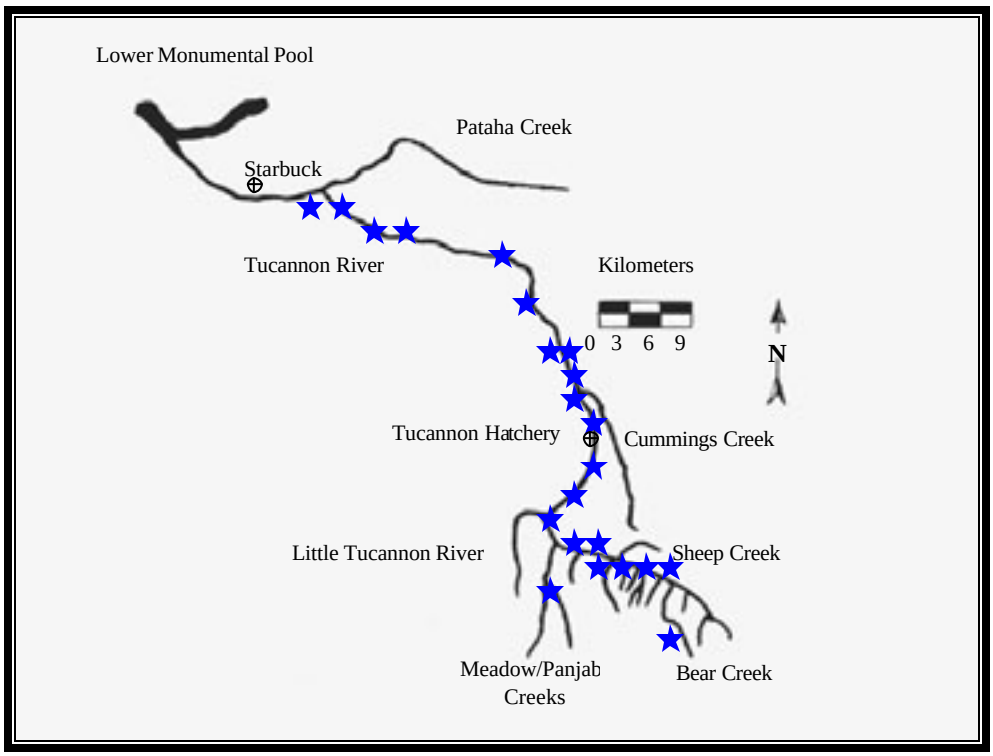

Figure 5. Distribution of radio-tagged bull trout in the Tucannon Subbasin in October and November, 2002. Each star may represent more than one fish location.

Depth Transmission Tests

Initial results showed that depth transmission of the MCFT-3A transmitters was poor. From the boat and air, we could audibly detect the transmitter placed at 25 ft., but the signal was not strong enough to display a code. The audible signal strength appeared to be stronger from the helicopter when using the "H" antenna vs. the Yagi, but this was most likely due to antenna mounting, placement, and positioning, rather than superior reception from the "H" antenna. Transmitters at all other depths projected no detectable signal at all, regardless of which antenna was used. During both tests, conductivities in Lower Monumental Pool ranged from 30-50 µmhos/cm.

Summary and Conclusions

Bull Trout Movements and Distribution

Bull trout generally moved upstream rapidly after recovering from tagging. By late June or early July most radio tagged bull trout had moved upstream into the Wenaha-Tucannon Wilderness, where all fishing is prohibited and water temperatures remain cold. In September, bull trout were located in known spawning areas that included the Tucannon River upstream of Bear Creek, Bear Creek, the Tucannon River between Panjab and Bear creeks, Meadow Creek and Turkey Creek.

Some bull trout initiated downstream movement from the spawning areas in September, and by late October or early November bull trout movements ceased. Very cold weather in late October and early November coincided with the cessation of movements by bull trout. By this time bull trout were scattered from the upper parts of the Wilderness downstream to near the mouth of Pataha Creek. Three radio tags were located below Highway 12, 4 from Highway 12 to the Hatchery, 16 from the Hatchery to the mouth of Sheep Creek, and the remaining 12 tags were within the Wenaha-Tucannon Wilderness Area upstream of Sheep Creek. The locations of fish downstream of Sheep Creek were monitored by both ground and aircraft, whereas those locations upstream of Sheep Creek were only monitored by aircraft. A fall drought, that included low stream flows and an unusually cold period in the last few days of October and early November, may have limited fall bull trout movements in the Tucannon River in 2002.

A fixed-site receiver near the mouth of the Tucannon River operated continuously since September 26, 2002. No radio tagged fish were detected at this site, or downstream during mobile tracking. Therefore, no radio tagged fish entered the Snake River, nor was any work completed in association with objectives 2, 3, or 4 of this study. Three radio tagged fish (codes 65, 83, 55) migrated down to the mouth of Pataha Creek. Untagged bull trout were reported downstream to the mouth of the Tucannon River by steelhead anglers, and a few were trapped by WDFW in the lower river.

Possible evidence of tag rejection/explusion was observed. In 2001, a bull trout telemetry study in the Touchet River conducted by the WDFW documented that some bull trout extruded their radio tags and subsequently survived for at least several weeks (draft annual report from WDFW, Dayton). It is possible that some of the Tucannon River fish also expelled their tags. In mid August, five individual radio-tagged bull trout were visually examined by snorkelers near the confluence of Panjab Creek and the mainstem of the Tucannon River. Two of those five fish appeared to have irritated or infected flesh surrounding the surgical incision. It is possible that radio-tagged fish exhibiting irritation at the incision site may be in the process of expelling their tag.

New Activities Planned for Spring and Summer 2003

WDFW will continue to integrate all radio tracking information into a single tracking summary for each fish to improve interpretation and understanding of fish movements. The investigators will continue to try and improve fish handling and tagging procedures to reduce tag loss and bull trout mortality from handling and tagging in 2003.

Some radio tags implanted into bull trout have an expected battery life of just over 1 year. Therefore, it is possible that the batteries in those radio transmitters may expire before the fish begin upstream movements in the spring. We hope to snorkel some of the radio tagged fish during spring and early summer of 2003 to try and confirm that they are in live bull trout before upstream migration begins. Detection of upstream movements would also confirm that radio tags are in live bull trout.

Depth Transmission Tests

Based on our initial test results, we may temporarily lose contact with radio-tagged bull trout that migrate to the Snake River if they utilize water depths greater than 20-25 feet. It is important to note, however, that it is highly unlikely these fish could pass Lower Monumental or Little Goose dams without being detected at the fixed stations installed there. We intend to expand our tests with different transmitters, frequencies, and manufacturers to help determine if there may be equipment available that would better suit our needs for monitoring bull trout in the Snake River reservoirs.

Summary of Expenditures

- Acquisition of two (2) SRX-400 (W-32) radio receivers from Lotek Engineering ($19,303).
- Aerial tracking (13.5 hours of helicopter time) to cover flights in September, October, and November ($8,127)
- PIT tag detectors (4) ($9,630).
- Helicopter Helmets (2) Gentex SPH-5 ($1,098).
- Nomex Flight Gear ($330)

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Appendix A: Bull Trout Trapping and Tagging Log, WDFW Tucannon Hatchery, 2002

Entry #	Date	Chan	Code	Pit Tag Code	Wt. (g)	L (cm)	T °C	SCALE #	DNA #	Water Temp	Comments
1	03/30/02					40					passed upstream
2	03/30/02					36					passed upstream
3	03/31/02					33					passed upstream
4	05/15/02										passed upstream
5	05/15/02										passed upstream
6	05/17/02	4	72	3D9.1BF1697693	640	38.5	8.3	TU1-1	BT02-TU01	47°F	released 100 m upstream of trap
7	05/17/02	4	74	3D9.1BF0EDB1EF	720	41	8.3	TU1-2	BT02-TU02	47°F	released 100 m upstream of trap
8	05/18/02										passed upstream
9	05/19/02	4	61	3D9.1BF168B791	380	33		TO2-3	BT02-TU03		released 100 m upstream of trap
10	05/19/02	4	58	3D9.1BF168B72A	400	35		TO2-4	BT02-TU04		released 100 m upstream of trap
11	05/19/02	4	76	3D9.1BF16948F4	600	36		TO2-5	BT02-TU05		released 100 m upstream of trap
12	05/19/02	4	62	3D9.1BF1694C4E	700	41		TO2-6	BT02-TU06		discoloration on nose tip, released 100 m upstream of trap
13	05/20/02	4	68	3D9.1BF1697197	1000	45		N/A	BT02-TU21		released 100 m upstream of trap
14	05/20/02	4	65	3D9.1BF1695190	1125	46		TU2-1	BT02-TU22		worm in gill, released 100 m upstream of trap
15	05/22/02	4	70	3D9.1BF168D096	740	41.5		TU2-2	BT02-TU20		fish died, tag recovered 6/13/02; released 100 m upstream of gate
16	05/22/02	4	71	3D9.1BF1678444	580	37		TU2-3	BT02-TU19		released 100 m upstream of the gate at river bend
17	05/25/02										passed upstream
18	05/26/02	4	64	3D9.1BF169505F	660	35.5	7.8	TU2-4	BT02-TU17	46°F	released 100 m upstream of the gate at river bend
19	05/26/02	4	75	3D9.1BF1694992	800	42	10.0	TU2-5	BT02-TU18	50°F	released 100 m upstream of the gate at river bend
20	05/26/02			3D9.1BF168D096	320	33	10.0	TU2-6	BT02-TU16		released 100 m upstream of the gate at river bend
21	05/26/02	4	77	3D9.1BF16776BE	920	41.5	10.0	TU2-7	BT02-TU15		released 100 m upstream of the gate at river bend
22	05/26/02			3D9.1BF1694136	660	52	10.0	TU2-8	BT02-TU14		aborted surgery; released 100 m upstream of gate
23	05/26/02			3D9.1BF168D444	680	41	10.0	TU2-9	BT02-TU13		released 100 m upstream of the gate at river bend
24	05/26/02			3D9.1BF1697900	720	41	10.0	TU2-10	BT02-TU12		released 100 m upstream of the gate at river bend
25	05/27/02										passed upstream
26	05/27/02										passed upstream
27	05/27/02										passed upstream
28	05/28/02	4	86	3D9.1BF1695EDC	2080	56	7.8	TU2-11	BT02-TU07	46°C	released 100 m upstream of the gate at river bend
29	05/28/02	4	79	not PIT - tagged	970	44	7.8	TU2-12	BT02-TU08		released 100 m upstream of the gate at river bend
30	05/28/02	4	67	3D9.1BF168CBDF	670	39	7.8	TU2-13	BT02-TU09		released 100 m upstream of the gate at river bend
31	05/28/02	4	73	3D9.1BF139501D	640	40.5	7.8	TU2-14	BT02-TU10		released 100 m upstream of the gate at river bend
32	05/29/02	4	84	3D9.1BF168CF0D	1900	55.8	10.0	TU3-1	BT02-TU23	10°C	released 100 m upstream of the gate at river bend
33	05/29/02	4	60	3D9.1BF16950AE	610	37.5	10.0	TU3-2	BT02-TU24	10°C	released 100 m upstream of the gate at river bend
34	05/29/02	4	83	3D9.1BF1695C76	1280	49.5	10.0	TU3-3	BT02-TU25	10°C	released 100 m upstream of trap
35	05/29/02	4	52	3D9.1BF1677BFB	800	40.6	10.0	TU3-4	BT02-TU30	10°C	released 100 m upstream of trap
36	05/30/02	4	59	3D9.1BF1696181	400	33.6	8.0	TU3-5	BT02-TU27	8°C	released 100 m upstream of trap
37	05/30/02	4	57	3D9.1BF1698811	780	40.1	8.0	TU3-6	BT02-TU28	8°C	released 100 m upstream of trap
38	05/30/02	4	54	3D9.1BF149543A	620	37.5	8.0	TU3-7	BT02-TU29	8°C	released 100 m upstream of trap
39	05/30/02	4	55	3D9.1BF1695D79	600	37.7	8.0	TU3-8	BT02-TU26	8°C	released 100 m upstream of trap
40	05/30/02	4		3D9.1BF1694699	350	34.2	9.0	None	BT02-TU31	9°C	released 100 m upstream of trap; too small for radio tag
41	05/30/02	4	81	3D9.1BF1677BE2	820	41.2	9.0	TU3-9	BT02-TU32	9°C	released 100 m upstream of trap
42	05/31/02	4	56	3D9.1BF1690D58	590	38	10.0	TU3-10	BT02-TU33	10°C	released 100 m upstream of trap
43	05/31/02	4	66	3D9.1BF1613944C	690	42	10.0	None	BT02-TU34	10°C	released 100 m upstream of trap
44	06/01/02	4	85	3D9.1BF169422A	820	41.9	7.5	TU3-11	BT02-TU35	7.5°	released 100 m upstream of trap
45	06/01/02			3D9.1BF169647F	390	33.6	7.5	TU3-12	BT02-TU36	7.5°	released 100 m upstream of trap, bleeding from gill -- not tagged
46	06/03/02			3D9.1BF169090B	360	32.7	11.1	TU3-13	BT02-TU37	52°F	released 100 m upstream of trap
47	06/03/02	4	63	3D9.1BF1678533	660	41.4	11.1	TU3-14	BT02-TU38	52°F	released 100 m upstream of trap
48	06/04/02	4	69	3D9.1BF168B983	720	41.5	10.0	TU3-15	BT02-TU39	10°C	released 100 m upstream of trap
49	06/04/02	4	53	3D9.1BF168ABBA	560	38.5	10.0	TU3-16	BT02-TU40	10°C	released 100 m upstream of trap
50	06/05/02			3D9.1BF1694E23		39					passed upstream
51	06/09/02			3D9.1BF11B832A		42					passed upstream
52	06/10/02			3D9.1BF1697B1E		40					passed upstream
53	06/11/02			3D9.1BF16978D6		37					passed upstream
54	06/11/02			3D9.1BF168C7CD		35					passed upstream
55	06/12/02			3D9.1BF1394DB8		33					passed upstream
56	06/12/02	4	82	3D9.1BF1678425	1625	53.5	11.7	TU3-17	BT02-TU41	53°F	released 100 m upstream of trap
57	06/13/02	4	78	3D9.1BF1678C18	1120	47	12.2	TU3-18	BT02-TU42	54°F	released 100 m upstream of trap
58	06/13/02	4	91	3D9.1BF0EDB77A	1200	48.5	13.3	TU3-19	BT02-TU43	56°F	released 100 m upstream of trap
59	06/13/02	4	88	3D9.1BF169680C	900	44.5	13.3	TU3-20	BT02-TU44	56°F	released 100 m upstream of trap
60	06/13/02	4	80	3D9.1BF1694009	2200	57	13.9	TU4-1	BT02-TU45	57°F	released 100 m upstream of trap
61	06/13/02			3D9.1BF168B985		30					passed upstream
62	06/13/02			3D9.1BF168ADF0		39					passed upstream
63	06/13/02			3D9.1BF1696DA3		36					passed upstream
64	06/13/02			3D9.1BF169A253		37					passed upstream
65	06/13/02			3D9.1BF16977BD		32					passed upstream
66	06/13/02			3D9.1BF169699C		32					passed upstream
67	06/14/02	4	70	3D9.1BF1699F97	670	40	12.2	TU4-2	BT02-TU46	54°F	released 100 m upstream of trap
68	06/14/02			3D9.1BF169A05A	600	39	12.2	TU4-3	BT02-TU47	54°F	released 100 m upstream of trap

69	06/14/02	4	89	3D9.1BF16769E7	1500	52	12.2	TU4-4	BT02-TU48	54°F	released 100 m upstream of trap
70	06/14/02			3D9.1BF168AB5F	720	38	12.2	TU4-5	BT02-TU49	54°F	released 100 m upstream of trap
71	06/14/02	4	87	3D9.1BF168B8D3	1020	45	12.2	TU4-6	BT02-TU50	54°F	released 100 m upstream of trap; scrape on upper mandible below nai
72	06/14/02	4	90	3D9.1BF1677542	1220	50	12.2	TU4-7	BT02-TU51	54°F	released 100 m upstream of trap
73	06/14/02			3D9.1BF16770DB		35	12.2	TU4-8	BT02-TU52	54°F	released 100 m upstream of trap
74	06/14/02			3D9.1BF1695020		36	12.2	TU4-9	BT02-TU53	54°F	released 100 m upstream of trap; cut on caudal peduncle
75	06/14/02			3D9.1BF1695028		34.5	12.2	TU4-10	BT02-TU54	54°F	released 100 m upstream of trap
76	06/15/02			3D9.1BF1691678		46					passed upstream
77	06/15/02			3D9.1BF1698829		55					passed upstream
78	06/15/02			3D9.1BF169711E		37					passed upstream
79	06/16/02			3D9.1BF1695CD1		34					passed upstream
80	06/16/02			3D9.1BF1695742		37					passed upstream
81	06/16/02			3D9.1BF1677D74		38					passed upstream
82	06/16/02			3D9.1BF168B92(?)		42					passed upstream
83	06/16/02			3D9.1BF1696A3A		37					passed upstream
84	06/18/02			3D9.1BF1694D3A		38					passed upstream
85	06/18/02			3D9.1BF1678430		56					passed upstream
86	06/18/02			3D9.1BF16954E3		34					passed upstream
87	06/18/02			3D9.1BF168B3F9		36					passed upstream
88	06/18/02			3D9.1BF169951B		37					passed upstream
89	06/18/02			3D9.1BF1695FEC		43					passed upstream
90	06/18/02			3D9.1BF1678437		37					passed upstream
91	06/18/02			3D9.1BF1394FB3		49					passed upstream
92	06/18/02			3D9.1BF168B6A7		40					passed upstream
93	06/18/02			3D9.1BF1697A96		37					passed upstream
94	06/18/02			3D9.1BF1694E61		35					passed upstream
95	06/21/02			3D9.1BF1696C73		35.5					passed upstream
96	06/21/02			3D9.1BF16788B4		45.7					passed upstream
97	06/21/02			3D9.1BF1696A17		35.5					passed upstream
98	06/21/02			3D9.1BF169AC57		51					passed upstream
99	06/21/02			3D9.1BF16977D9		45.3					passed upstream
100	06/21/02			3D9.1BF1696A1F		39.5					passed upstream
101	06/21/02			3D9.1BF168C5D5		38					passed upstream
102	06/21/02		71	3D9.1BF1678444		37					same fish as in entry #16; passed upstream
103	06/24/02			3D9.1BF16947E6		44					passed upstream
104	06/24/02			3D9.1BF1696046		46					passed upstream
105	06/24/02			3D9.1BF1692C46		54					passed upstream
106	06/24/02			3D9.1BF1695D1D		38					passed upstream
107	06/24/02			3D9.1BF168999E		32					passed upstream
108	06/24/02			3D9.1BF169654B		36					passed upstream
109	06/24/02			3D9.1BF168B3DF		44					passed upstream
110	06/24/02			3D9.1BF168C71C		44					passed upstream
111	06/24/02			3D9.1BF168B70D		37					passed upstream
112	06/24/02			3D9.1BF1395016		42					passed upstream
113	06/24/02			3D9.1BF1676C49		34					passed upstream
114	06/24/02			3D9.1BF1676EE5		30					passed upstream
115	06/24/02			3D9.1BF1678224		34					passed upstream
116	06/25/02										passed upstream
117	06/25/02										passed upstream
118	06/25/02										passed upstream
119	06/25/02										passed upstream
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126	06/25/02										passed upstream
127	06/25/02										passed upstream
128	06/25/02										passed upstream
129	06/26/02			not PIT - tagged			15.6			stream temp 6(	passed upstream
130	06/26/02										passed upstream
131	06/26/02										passed upstream
132	06/26/02										passed upstream
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161	06/28/02	passed upstream
162	06/29/02	passed upstream
163	06/29/02	passed upstream
164	06/29/02	passed upstream
165	06/29/02	passed upstream
166	06/29/02	passed upstream
167	06/29/02	passed upstream
168	07/01/02	passed upstream
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174	07/01/02	passed upstream
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176	07/05/02	passed upstream
177	07/05/02	passed upstream
178	07/08/02	passed upstream
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186	07/11/02	passed upstream
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193	07/11/02	passed upstream
194	07/12/02	passed upstream
195	07/15/02	passed upstream
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201	07/15/02	passed upstream
202	07/29/02	passed upstream
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205	07/29/02	passed upstream
206	07/29/02	passed upstream
207	07/31/02	passed upstream
208	07/31/02	passed upstream
209	07/31/02	passed upstream